Ontario

Apprenticeship
In-school Curriculum Standards

Steamfitter

Level 2

307A

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Introduction

This new curriculum standard for the Steamfitter trade is based upon the on-the-job performance objectives, located in the industry-approved training standard.

The curriculum is organized into 3 levels of training. The Program Summary of Reportable Subjects chart summarizes the training hours for each reportable subject.

The curriculum identifies only the learning that takes place off-the-job. The in-school program focuses primarily on the theoretical knowledge and the essential skills required to support the performance objectives of the Apprenticeship Training Standards. Employers/Sponsors are expected to extend the apprentice's knowledge and skills through practical training on the work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to ensure that all apprentices have achieved the learning outcomes identified in the curriculum standard.

It is not the intent of the in-school curriculum to perfect on-the-job skills. The practical portion of the in-school program is used to reinforce theoretical knowledge. Skill training is provided on the job.

STEAMFITTER - LEVEL 2

Program Summary of Reportable Subjects - Level 2

Level II	Reportable Subjects	Hours Total	Hours Theory	Hours Practice
1	Pipe Fabrication II	48	3	45
2	Steamfitting Systems II	120	95	25
3	Applied Trade Calculations II	24	12	12
4	Trade Documentation II	24	11	13
5	Welding II	24	3	21
	Total	**240**	**124**	**116**

STEAMFITTER - LEVEL 2

Number: **S0927**

Reportable Subject: **PIPE FABRICATION II**

Duration: Total 48 nours Theory 3 hours Application 45 hours

Prerequisites: Level I

Content:

S0927.1 Fabrication Layout
S0927.2 Tube and Pipe Bending
S0927.3 Steam Boiler Project

Evaluation & Testing: Assignments related to theory and appropriate application skills.
Minimum of one mid-term test during the 8-week term.
Final exam at end of term.
Periodic quizzes.

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
10%	80%	10%

Instructional and Delivery Strategies: Delivery of theory and practical will be closely aligned. Use of templates from the Trade Documentation II reportable subject to build shop projects will test the theory of template development. The use shop project pipe fittings in the Welding II reportable subject classes will reinforce the need for well fitted welding joints. The building of boiler and piping systems will reinforce theory learned in the Steamfitting Systems reportable subject.

Reference Materials:

IPT Pipe Trade Handbook
Pipe Fitters and Welders Handbook
Alberta steamfitting modules

Recommended Equipment List:

grinders, side and pencil
oxyacetylene cutting torches
face shields with both clear and dark lenses
wrap arounds, small for 6 inch pipe
contour marker
centre punches and cold chisels of different sizes
soap stones and paint stick markers
levels, 24 inch, 48 inch and torpedo
ball pein and small sledge hammers
chop saw and cut off saw
porta-band saw with spare blades
adjustable roller stands
spacing tools and lineup clamps
squares, 24 inch and tri-square
scissors, template paper
tri stands
hydraulic pipe bender
tube benders
steam boiler with accessories and controls
zone valves
heat transfer units
steam traps

STEAMFITTER - LEVEL 2

S0927.1 Fabrication Layout

Duration: Total 16 hours Theory 1 hours Practical 15 hours

Cross-Reference to Training Standard: 5470.0, 5471.0, 5472.0, 5474.0, 5480.0, 5482.0, 5483.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to use templates and pipe fabrication techniques in accordance with industry standards.

LEARNING OUTCOMES AND CONTENT

1.1 Describe template design techniques

1.2 Identify template Practicals

1.3 Describe fabrication layout techniques

1.4 Identify fabrication layout Practicals

1.5 Apply pattern drafting knowledge to fabricate assigned class projects from the following list:

- a 2-piece 90° elbow
- a 3-piece 90° elbow
- a 45° lateral reducing tee
- a full size tee
- a dummy leg

STEAMFITTER - LEVEL 2

S0927.2 Tube and Pipe Bending

Duration: Total 16 hours Theory 2 hours Practical 14 hours

Cross-Reference to Training Standard: 5470.0, 5471.0, 5472.0, 5474.0, 5480.0, 5482.0, 5483.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to apply trade calculations involving tube bending operations in accordance with manufacturers' recommendations and accepted industry standards.

LEARNING OUTCOMES AND CONTENT

2.1 Explain the following tube and pipe bending methods:

- compression bending
- draw bending
- roll bending
- tension bending
- ram and press bending

2.2 Define the following terms as they relate to tube or pipe bending:

- degree of bend
- radius of bend
- radii
- developed length
- gain
- leg length
- stationary bending form
- rotating bending form
- movable pressure form
- ram and press bending

2.3 State the formula for tube bending allowance

2.4 Give minimum radii for bending various sized tubing

2.5 Perform tube bending on copper tubing and steel pipe

S0927.3 Steam Boiler Project

Duration: Total 16 hours Theory 0 hours Practical 16 hours

Cross-Reference to Training Standard: 5470.0, 5471.0, 5472.0, 5474.0, 5480.0, 5482.0, 5483.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to correctly install a steam boiler heating system.

LEARNING OUTCOMES AND CONTENT

3.1 Build a steam boiler piping and control system including:
- a steam boiler
- accessories and controls
- a zone valve
- a heat transfer unit
- a steam trap

STEAMFITTER - LEVEL 2

Number: **S0928**

Reportable Subject: **STEAMFITTING SYSTEMS II**

Duration: Total 120 hours Theory 93 hours Practical 27 hours

Prerequisites: Level I

Content:

Hot Water System Controls

S0928.1 Zoning Applications
S0928.2 Two-Way Valves
S0928.3 Three-Way Valves
S0928.4 Four-Way Valves
S0928.5 Primary and Secondary Pumps
S0928.6 Injection Pumps

Low Pressure Steam Systems

S0928.7 Low Pressure Steam System Principles
S0928.8 Properties of Steam
S0928.9 Gravity Steam Systems
S0928.10 Mechanical Steam Systems
S0928.11 Condensate Pump Systems
S0928.12 Vacuum Pump Systems
S0928.13 Lift Fittings
S0928.14 Sub-Atmospheric Systems
S0928.15 Steam Traps

Heat Transfer Units

S0928.16 Converters and Heat Exchangers

High Pressure Steam Systems

S0928.17 High Pressure Steam System Principles
S0928.18 High Pressure Steam Plants
S0928.19 Pressure Reducing Valves and Stations
S0928.20 Economizers
S0928.21 Condensers
S0928.22 Feedwater Heater and Deaerator
S0928.23 Superheaters
S0928.24 Desuperheaters
S0928.25 Blowdown Tanks and Piping

Steam Boilers and Accessories

S0928.26 Steam Boilers
S0928.27 Steam Boiler Piping
S0928.28 Accessories and Controls
S0928.29 Feedwater Controls and Piping

Electrical

S0928.30 Electrical Fundamentals
S0928.31 Stress Relieving

Evaluation & Testing: Assignments related to theory and appropriate Practical skills.
Minimum of one mid-term test during the 8-week term.
Final exam at end of term.
Periodic quizzes.

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
60%	10%	30%

Instructional and Delivery Strategies: Delivery of theory will be coordinated with the building of boiler and piping systems in the Pipe Fabrication II reportable subject.

Reference Materials: Alberta steamfitting modules

Recommended Equipment List:

several small steam boilers (high & low pressure) from different manufacturers
Steam piping systems, steam & condensate return
condensate return pumps
feed water and cutoff controllers
low-water cut off controls
steam, cast iron radiators
water column c/w tri-cocks & sight gauges
relief valve and drip pan elbow
hydronic system display
manual valve displays with all types with cutaways to show interior
control valve display 2 way, 3 way, 4 way, zone valve

thermostatic steam trap
thermodynamic steam trap
float & thermostatic steam trap
bucket steam trap
shell & tub heat exchangers & converters
plate type heat exchangers & converters
pressure reducing valve station display
steam control valve display
blowdown tank display various types of:

- multimeters
- ampmeters
- ohmmeters
- voltmeters

electrical board for testing and demonstrating:

- series circuit
- parallel circuit
- combine circuit
- motor control

STEAMFITTER - LEVEL 2

S0928.1 Zoning Applications

Duration: Total 4 hours Theory 3 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to explain the purpose and reasons for zone heating applications.

LEARNING OUTCOMES AND CONTENT

1.1 Explain the purpose of hot water heating zoning applications

1.2 Define a heating zone

1.3 Explain the four major reasons for zoning a heating system

1.4 Describe the type of building suitable for a zoned heating system

1.5 Define "stack effect"

1.6 Explain the reason a heating system would be zoned for multi-use occupancy

1.7 Name the five basic methods of controlling zoned hot water heating systems

1.8 Draw a simple one-line sketch of a single storey building zoned to alleviate stack effect

1.9 Draw a simple one-line sketch of a single storey building containing offices and a factory area

1.10 Draw a simple single-line sketch of a rectangular-shaped building divided into zones for geographical reasons

STEAMFITTER - LEVEL 2

S0928.2 Two-Way Valves

Duration: Total 3 hours Theory 3 hours Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the operation and practical of two-way valves.

LEARNING OUTCOMES AND CONTENT

2.1 Describe the operation and Practical of a two-way valve

2.2 Name the two basic types of two-way zone control valves

2.3 Explain the type of two-way valve used for heating units subject to freezing temperatures

2.4 Name the three main parts of the two-way valves

2.5 Name the three basic types of actuating devices

2.6 Identify the type of seating arrangement used in balanced-type two-way valves

2.7 Explain the two basic methods of operation on pneumatically operated valves

2.8 List three advantages of using two-way valves

2.9 List four disadvantages of using two-way valves

2.10 Identify the control device used for electric motor or pneumatically actuated valves

STEAMFITTER - LEVEL 2

S0928.3 Three-Way Valves

Duration: Total 3 hours Theory 2 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the operation and practical of three-way valves.

LEARNING OUTCOMES AND CONTENT

3.1 Describe the operation and Practical of a three-way valve

3.2 Identify the two basic types of three-way zone control valves

3.3 Illustrate the piping connections to and from each type of three-way valve

3.4 List the type of heating systems in which three-way control valves are usually found

3.5 Identify the method usually used to identify whether the valve is a mixing or diverting valve

3.6 Identify the two control devices used to operate three-way valves

3.7 Identify the two actuating methods used by three-way valves

3.8 List four advantages of using three-way valves in a zoned system

3.9 Name two disadvantages of using three-way valves in a zoned system

3.10 Identify two general instructions which should be followed when installing three-way valves

3.11 Define "common piping"

3.12 Describe the Practical and explain what happens in the secondary circuit when a restriction is placed in the common piping

3.13 Draw a single-line drawing of a mixing valve indicating the port openings by the letters "a" and "b"

3.14 Draw two single-line drawings showing the two locations in a zone where three-way mixing valves may be installed

3.15 Draw a single-line drawing of a diverting valve indicating the port openings by the letters "a" and "b"

3.16 Draw a single-line drawing correctly locating the diverting valve in a zone system

STEAMFITTER - LEVEL 2

S0928.4 Four-Way Valves

Duration: Total 3 hours Theory 3 hours Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the operation and practical of four-way valves.

LEARNING OUTCOMES AND CONTENT

4.1 Describe the operation and Practical of a four-way valve

4.2 Name the basic types of four-way valves

4.3 Explain the operating principles of a four-way valve

4.4 Describe how the four-way valve contributes to the system

S0928.5 Primary and Secondary Pumps

Duration: Total 6 hours Theory 4 hours Practical 2 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the operation and practical of primary and secondary pumps.

LEARNING OUTCOMES AND CONTENT

5.1 Describe the operation and Practical of primary and secondary pumps

5.2 State the purpose of a primary pump

5.3 State the purpose of a secondary pump

5.4 State the purpose of a primary circuit

5.5 Describe the three basic system designs which may be used for primary circuits

5.6 Describe the two main factors which are considered when selecting the system to use for the primary circuit

5.7 State the number of secondary zones which may be installed on a primary circuit

5.8 State five systems or pieces of heat transfer equipment which can be used as secondary zones

5.9 Describe the two types of control used by secondary zones

5.10 Name the three control devices used to activate secondary zone pumps

5.11 Identify the extra piece of equipment (in addition to the zone pump) necessary to enable the zone to operate efficiently in zones using continuous pump operation

5.12 Name the two sensing devices used to activate the control valve located in the zone using continuous pump operation

5.13 List five advantages of zoning with pumps versus other control devices

5.14 Calculate the G.P.M. flow and temperatures for an intermittently operated zone when 5 G.P.M. at 250°F boiler water is supplied to the zone by-pass and the zone pump requires 15 G.P.M. and a 20°F temperature drop occurring in the secondary zone

5.15 Draw a single-line illustration of a one-pipe primary circuit and secondary zone locating boiler, primary pump, flow control valves and secondary pump, indicating direction of flow

5.16 Draw a single-line illustration showing a view of a zone using intermittent zone pump operation with pump off, indicating flow velocities and temperatures

5.17 Draw a single-line illustration showing a view of a zone using intermittent zone pump operation with pump on, indicating flow velocities and temperatures

5.18 Draw a single-line illustration showing a view of a zone using continuous pump operation with valve open, indicating flow velocities and temperatures

S0928.6 Injection Pumps

Duration: Total 2 hours Theory 2 hours Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the operation and practical of injection pumps.

LEARNING OUTCOMES AND CONTENT

6.1 State the purpose of an injection pump

6.2 Describe the operation of an injection pump

6.3 State the definition of the term 'metering'

6.4 State the two main parts of an injection pump

6.5 State the main type of injection pumps

6.6 State the purpose of check valves in an injection pump

6.7 Describe when diaphragm and peristaltic pumps are used

6.8 Describe possible problems arising from use of injection pumps

S0928.7 Low Pressure Steam System Principles

Duration: Total 3 hours Theory 3 hours Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe low pressure steam system principles.

LEARNING OUTCOMES AND CONTENT

7.1 Explain the main function of any heating system

7.2 Explain the three functions that every system should perform

7.3 Explain why low pressure steam is used for heating purposes

7.4 State the operating pressure of low-pressure steam heating systems

7.5 Name the three main components of a steam heating system

7.6 Identify the three basic features used to classify steam heating systems

7.7 State the four basic types of systems classified by the pressure or vacuum conditions which exist during actual operation

7.8 State the operating pressure used in vacuum-type systems

7.9 Identify two other names for a sub-atmospheric steam heating system

7.10 State three mechanical devices used to return condensate to the boiler
Interpret the classification chart which indicates the various types of steam heating systems

7.11 Draw a single-line sketch of the basic steam heating cycle and identify the main components of the low-pressure steam systems

7.12 Draw a single-line sketch of:

- a wet return system
- a dry return system

S0928.8 Properties of Steam

Duration: Total 9 hours Theory 8 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the properties of steam.

LEARNING OUTCOMES AND CONTENT

8.1 Describe the properties of steam

8.2 List what type of heat is required to convert liquid water to steam

8.3 State another term for steam

8.4 State the number of times water expands when it is changed to steam

8.5 Name three different types of steam

8.6 Describe the location in the system where "dry" saturated steam can be found

8.7 Name the type of system in which superheated steam will usually be found

8.8 State the reason-superheated steam behaves like a true gas

8.9 State the names of two laws of physics governing true gases

8.10 State the reason "dry" saturated steam is used for steam-heating systems

8.11 Draw a single-line sketch showing where both "wet" and "dry" saturated steam can be found in a heating system

8.12 Identify the letter designations used in steam tables for each of the following:

- heat content of liquid
- latent heat of vaporization
- heat content of steam
- volume of steam

STEAMFITTER - LEVEL 2

S0928.9 Gravity Steam Systems

Duration: Total 4 hours Theory 2 hours Practical 2 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe gravity steam systems.

LEARNING OUTCOMES AND CONTENT

9.1 Identify gravity steam systems

9.2 Explain why the design of gravity steam heating systems is extremely important

9.3 Explain why all heat transfer units must be located above the boiler in a gravity steam system

9.4 Explain why the water level in the condensate return main furthest from the boiler is higher than the boiler water line (wet return)

9.5 Explain why gravity steam heating systems operate at pressure below 10 PSIG

9.6 Explain what would happen if higher operating steam pressures were used in gravity steam systems

9.7 State the two locations where air vent valves are found in a gravity steam heating system

9.8 State the location of air vent valves installed on radiators

9.9 Name three advantages of using gravity steam heating systems

9.10 Name four disadvantages of using gravity steam heating systems

9.11 Explain why gravity steam heating systems are not used in large buildings

9.12 Explain why one-pipe gravity steam systems are so named

9.13 Describe the valve operation sequence for radiators using two connections

9.14 Calculate the theoretical height of the condensate water level in the condensate return main for a boiler operating at 0.25 PSIG

9.15 Draw and label the following sketches of gravity steam systems:

- a single-line sketch of a one-pipe, mains grading up, gravity steam system
- a piping sketch of the risers and runouts to the main where risers are not dripped
- a sketch of piping and fittings used when reductions are made in the steam mains
- a sketch of piping, connecting the risers and runouts to the main when risers are dripped to a wet return
- a single-line sketch of a two-pipe, mains grading down, (wet-return) gravity steam system indicating water legs

STEAMFITTER - LEVEL 2

S0928.10 Mechanical Steam Systems

Duration: Total 4 hours Theory 3 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe mechanical steam systems.

LEARNING OUTCOMES AND CONTENT

10.1 Describe the types and operation of mechanical steam systems

10.2 Define "mechanical steam" systems

10.3 Name the four common types of mechanical steam systems

10.4 State the operating pressures found in the steam and condensate mains of a *condensate pump system*

10.5 State the operating pressures found in the steam and condensate mains of a vacuum pump system

10.6 State the operating pressures found in the steam and condensate mains of a sub-atmospheric system

10.7 Describe the main purpose of a steam trap

10.8 Explain where steam traps are usually located

10.9 Explain the type of radiator valves used on vacuum pump systems

10.10 Draw and label a sketch of a condensate pump system including heat transfer units, steam traps, radiator valves and piping

S0928.11 Condensate Pump Steam Systems

Duration: Total 3 hours Theory 2 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to define the fundamentals and operation of condensate pump steam systems.

LEARNING OUTCOMES AND CONTENT

11.1 Describe the operation of a condensate pump steam heating system

11.2 List the advantages of using a condensate pump steam heating system compared to a:
- boiler return trap system
- gravity system

11.3 Name the two valves located on the piping from the condensate pump to the boiler

11.4 State the maximum operating pressure used in low pressure steam systems

11.5 State the pressure found in the condensate return lines

11.6 State the reason for the steam main pitching down in the direction of steam flow

11.7 Explain why a valve is located at the inlet to each heat transfer unit

11.8 Explain what happens to any air which is in the steam system

11.9 State the main type of pump used in low pressure steam systems

11.10 State the three main components usually fitted on a common base in condensate pump systems

11.11 Describe the method used to size condensate receivers

11.12 Describe the method used to size condensate pumps

11.13 Identify and describe the two control methods used in condensate pump steam systems

11.14 State the main reason for locating the condensate pump unit at a low level

11.15 State the reason for using unions and valves on connections to the condensate receiver

11.16 State the minimum size of the vent line from the condensate receiver

11.17 Determine the size of the piping from the condensate pump to the boiler

11.18 Describe the main function of any steam heating system

11.19 Define the term "spring piece"

11.20 Define the term "runout"

11.21 Draw and label the following sketches of condensate pump systems:

- a single-line illustration of a condensate pump system indicating the boiler, the condensate pump and receiver, two radiators, steam traps and valves
- a single-line illustration of a condensate pump connected to a steam boiler through a hartford loop
- a single-line illustration of the end of a steam main correctly dripped and trapped
- a single-line illustration of an "equalizing line" between the steam and condensate mains of a steam system
- single-line illustration of the piping connections to a horizontal-type unit heater where steam and condensate mains are run at high level (above the heater)

11.22 Illustrate and explain the piping arrangement for installing a steam line around a steel beam

STEAMFITTER - LEVEL 2

S0928.12 Vacuum Pump Systems

Duration: Total 3 hours Theory 2 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to define the fundamentals and operation of vacuum pump steam systems.

LEARNING OUTCOMES AND CONTENT

12.1 Describe the fundamentals and operation of a vacuum pump system

12.2 Explain the reason for the difference between the pressures in the steam and condensate piping in mechanical steam heating systems

12.3 Describe what causes the pressure difference in the vacuum pump steam system

12.4 Describe what kind of pressure condition exists in the steam lines of a vacuum pump steam system

12.5 Describe what kind of pressure condition exists in the condensate return lines of the vacuum pump steam system

12.6 Name the type of building where vacuum steam systems are usually installed

12.7 Explain why vacuum pump steam systems are not usually installed in small residential buildings

12.8 Describe the purpose of the vacuum pump in a steam system

12.9 State the recommended grade for piping in a vacuum pump steam heating system

12.10 Explain why pipe sizes in vacuum pump steam heating systems are usually smaller than those in other mechanical steam heating systems

12.11 State the pressure usually maintained in the steam lines of a vacuum pump steam heating system

12.12 State the pressure usually maintained in the condensate return lines of the vacuum pump steam heating system

12.13 List three advantages of the vacuum pump system compared to the condensate pump system

12.14 Name the two types of vacuum pump units

12.15 List the three main factors to consider when selecting and sizing the vacuum pump

12.16 Describe what causes water to be discharged from the air-separating tank to the boiler

12.17 State the pressure range of steam traps used in vacuum steam heating systems

12.18 State the type of valve used at the inlet to the radiators

12.19 Describe the two methods used to cool high-temperature condensate before returning it to the vacuum condensate line

12.20 Draw and label a single-line illustration of a vacuum pump steam system with two radiators

12.21 Draw and label a single-line illustration of an equalizing line showing a steam trap on the line

12.22 State the purpose of a flash tank

12.23 Draw and label a single-line illustration of a flash tank where the exhaust steam is directed to the low-pressure steam line

S0928.13 Lift Fittings

Duration: Total 1 hour Theory 1 hour Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to define the fundamentals and operation of lift fittings.

LEARNING OUTCOMES AND CONTENT

13.1 Describe the purpose and Practical of lift fittings

13.2 Describe the installation procedures for lift fittings

STEAMFITTER - LEVEL 2

S0928.14 Sub-Atmospheric Systems

Duration: Total 3 hours Theory 3 hours Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to define the function and use of sub-atmospheric systems.

LEARNING OUTCOMES AND CONTENT

14.1 Define the sub-atmospheric steam system

14.2 State the purpose of sub-atmospheric steam system

14.3 List the three major factors to be considered when designing or installing any heating system

14.4 Name the two recognized methods of control used by steam heating systems

14.5 Describe the method of control used in sub-atmospheric steam heating systems

14.6 Explain why the sub-atmospheric steam system is similar to a vacuum steam system

14.7 Compare the range of pressures used by the sub-atmospheric steam system to those used by the vacuum system

14.8 Describe the weather conditions which would cause the sub-atmospheric steam system to operate at 2 PSIG

14.9 Describe the weather conditions which would cause the sub-atmospheric steam system to operate at 25 inches of mercury

14.10 Name the type of pump usually used by sub-atmospheric steam heating systems

14.11 List three advantages of sub-atmospheric steam systems

14.12 Name two disadvantages of sub-atmospheric steam systems

14.13 List five pieces of equipment used exclusively on the sub-atmospheric steam heating system

14.14 State the pressure range of steam traps used in sub-atmospheric steam systems

14.15 State the only location where a lift fitting is permitted in a sub-atmospheric steam system

14.16 Describe the effect on the boiling point of water when the pressure is decreased

14.17 Describe the effect on the volume of steam when the pressure is decreased

14.18 Describe the effect on the heat content of one pound of steam when the pressure is decreased

14.19 State the methods used to control heat during periods of mild weather (60°F to 65°F outside temperatures)

14.20 Describe the features of sub-atmospheric controls and equipment

STEAMFITTER - LEVEL 2

S0928.15 Steam Traps

Duration: Total 4 hours Theory 3 hours Practical 1 Hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the fundamentals and operation of steam traps.

LEARNING OUTCOMES AND CONTENT

15.1 State the purpose of steam traps

15.2 State the basic requirement for all steam traps

15.3 Define steam trap

15.4 Name the three basic classifications of steam traps

15.5 Name the two types of thermodynamic steam traps

15.6 Name the three types of mechanical steam traps

15.7 Explain why the corrugated bellows trap is sometimes referred to as a "balanced pressure trap"

15.8 Name the type of volatile liquid usually found inside the bellows or disc of a thermostatic steam trap

15.9 Describe where thermostatic steam traps are usually installed

15.10 State the purpose of the thermostatic element in the float and thermostatic steam trap

15.11 State the purpose of the float mechanism in the float and thermostatic steam trap

15.12 State the usual operating pressure range of float and thermostatic steam traps

15.13 Describe where float and thermostatic steam traps are usually installed

15.14 State the two reasons the upright bucket trap has fallen into disfavour

15.15 Describe how air is vented from beneath the bucket of an inverted bucket trap

15.16 Identify the other name by which thermodynamic steam traps are known

15.17 State the operating pressure range of thermodynamic steam traps

15.18 State the maximum superheated steam temperature the thermodynamic steam trap is able to withstand

15.19 Explain the principle by which the thermodynamic steam trap operates

15.20 Draw and label a single-line illustration of steam traps connected to three blast coils

15.21 Draw and label a single-line illustration of the condensate return piping arrangement required by a heat transfer unit located below the condensate return lines

15.22 State the height of a water column supported by a given pressure

15.23 Name five considerations when selecting a steam trap

S0928.16 Converters and Heat Exchangers

Duration: Total 9 hours Theory 8 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the fundamentals, practical, construction and operation of converter and heat exchanger heat transfer units.

LEARNING OUTCOMES AND CONTENT

16.1 Describe the following terms as they apply to heat transfer units:
- heat exchanger
- converter
- pass

16.2 List the three main components of heat exchangers and converters

16.3 State three materials used in the manufacture of heat exchanger and converter "shells" and "tube bundles"

16.4 Describe plate type heat exchangers

16.5 List four Practicals where heat exchangers or converters are used

16.6 Identify the three main types of tube bundles

16.7 Name the end of heat exchangers or converters into which tubes are inserted

16.8 State the purpose of the bowed design of tube bundles

16.9 Identify the component of the converter or heat exchanger that determines the number of passes

16.10 State three important factors used to select the type and size of heat exchanger or converter

16.11 Explain the two main reasons why shell and tube heat exchangers and converters should pitch upward at the front

16.12 Identify the device used to regulate the steam control valve on the inlet to the shell of the converter

16.13 Identify the type and size of valve used as a vacuum breaker on the converter shell

16.14 Explain why heated water from a boiler is usually piped into the bottom tapping of the heat exchanger or converter shell

16.15 Describe the operating principles of double wall heat exchangers and converters with or without leak detection

16.16 Describe the installation procedures of double wall heat exchanger and converter system components

16.17 State the reason for installing a vacuum breaker on the shell of the converter

16.18 Draw single-line sketches of the following:

- a heat exchanger shell indicating inlets and outlets
- a heat exchanger or converter with a two-pass head
- a heat exchanger or converter with a four-pass head
- a heat exchanger correctly installed on a steam boiler
- a converter complete with piping connections to both the shell and tubes to supply heat for a hot water heating system
- a plate type heat exchanger

STEAMFITTER - LEVEL 2

S0928.17 High Pressure Steam System Principles

Duration: Total 3 hours Theory 2 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe high pressure steam systems.

LEARNING OUTCOMES AND CONTENT

17.1 Describe features of high-pressure steam systems

17.2 State the three recognized subdivisions of high-pressure steam

17.3 Identify the maximum pressure recommended for high-pressure steam heating systems

17.4 Identify the two basic pressure classifications for saturated steam

17.5 Describe where the high and low pressure classifications can usually be found

17.6 State the purpose of generating low-pressure steam

17.6 Identify four uses for process steam

17.8 Describe two important advantages of using high pressure steam

17.9 Calculate the latent heat in one cubic foot of steam at a given pressure using a steam table

S0928.18 High Pressure Steam Plants

Duration: Total 2 hours Theory 1 hour Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe high pressure steam plants.

LEARNING OUTCOMES AND CONTENT

18.1 State the purpose of high-pressure steam plants

18.2 State two main considerations which will ultimately determine the type of high-pressure steam plant installed

18.3 Identify three types of heat transfer equipment

18.4 Explain the prime reason for installing additional pieces of equipment in condensing and non-condensing steam plants

18.5 State the two basic types of high-pressure steam plants

18.6 Explain the fundamental operation of the following steam plants:
- a condensing steam plant
- a non-condensing steam plant
- a steam-driven nuclear power plant
- a coal-driven power plant

18.7 State two main reasons for installing a non-condensing steam plant

18.8 Describe the type of feedwater heater usually found in the following:

- a condensing steam plant
- a non-condensing steam plant

18.9 Draw a single-line sketch of the main components including equipment required for efficient operation of following steam plants:

- a condensing steam plant
- a non-condensing steam plant
- a nuclear power plant
- a coal power plant

S0928.19 Pressure Reducing Valves and Stations

Duration: Total 3 hours Theory 3 hours Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe pressure reducing valves and stations.

LEARNING OUTCOMES AND CONTENT

19.1 Describe the fundamentals of pressure reducing valves and stations

19.2 Explain the purpose of a pressure-reducing valve

19.3 Identify the two basic types of pressure reducing valves used to reduce high-pressure steam

19.4 Define a pilot operated pressure-reducing valve

19.5 Describe where a spring-operated type of pressure reducing valve is used

19.6 Describe which type of pressure reducing valve has a larger diaphragm chamber

19.7 Describe the two valve body designs used for pressure reducing valves

19.8 Explain where single-seated pressure reducing valves are used

19.9 Explain where double-seated pressure reducing valves are used

19.10 Explain the two important considerations when selecting a pressure-reducing valve

19.11 Describe reducing valve installation procedures

19.12 Identify the minimum distance between reducing valves installed in series

19.13 Identify parallel pressure reducing valve installations

19.14 State where series or parallel pressure reducing valve installations would be used

19.15 Identify the size of pressure reducing valve control-line piping

19.16 State the purpose of by-pass piping and valves installed with pressure reducing valves

19.17 Explain the reason for priming the control-line piping before putting the pressure-reducing valve into operation

19.18 Explain the reason for installing a safety valve on the low-pressure piping of a pressure-reducing valve

19.19 Identify the type of reducing coupling used to increase pipe size on the downstream side of the pressure-reducing valve

19.20 Draw an isometric sketch of a pressure-reducing valve installed in a pipeline, together with equipment and piping needed to ensure efficient operation of the valve

S0928.20 Economizers

Duration: Total 2 hours Theory 1 hour Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe economizers.

LEARNING OUTCOMES AND CONTENT

20.1 Describe the fundamentals of economizers

20.2 Explain the main reason for using economizers

20.3 State the two main metals used in the manufacture of economizers

20.4 Explain why cast-iron economizers are selected for some installations

20.5 Explain why steel economizers are selected for some installations

20.6 State the reason for keeping the feedwater temperature to each economizer above a specified minimum temperature

20.7 Describe how economizer's internal and external surfaces are kept clean

20.8 Explain why forced draft must be used when economizers are installed

20.9 Draw a single-line sketch showing the correct location of the following:
- an integral economizer
- a separate unit economizer

STEAMFITTER - LEVEL 2

S0928.21 Condensers

Duration: Total 1 hour Theory 1 hour Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe condensers.

LEARNING OUTCOMES AND CONTENT

21.1 Describe the basic function of a condenser

21.2 Identify the two basic categories of condensers

21.3 Describe the main difference in the operation of a direct contact condenser and a surface condenser

21.4 State the three main classifications of direct contact condensers

21.5 Explain "counterflow" condensers

21.6 Explain "parallel flow" condensers

21.7 Identify the type of medium traveling through the tubes of a surface condenser

21.8 Calculate the velocity at which cooling water travels through the tubes of the surface condenser

21.9 Explain the reason for even distribution of steam over the cooling tubes in the surface condenser

21.10 Describe how surface condensers are supported

STEAMFITTER - LEVEL 2

S0928.22 Feedwater Heaters and Deaerators

Duration: Total 6 hours Theory 5 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe feedwater heaters and deaerators.

LEARNING OUTCOMES AND CONTENT

22.1 Describe the fundamentals of feedwater heaters and deaerators

22.2 Identify the three classifications of impurities found in water

22.3 Describe the method usually used to remove suspended matter from water

22.4 Identify the types of solids in solution which form soft sludge-like scale when precipitated

22.5 Identify the types of solids in solution which form hard scale when precipitated

22.6 Explain the reason for removing sulphates and bicarbonates from feedwater
List the three main types of dissolved gases usually found in feedwater

22.7 List the materials that are attacked by the ammonia gas carried along with the steam

22.8 Calculate the percentage increase in efficiency when feedwater temperature is raised by 5°C

22.9 Define the term "thermal shock"

22.10 List four advantages of installing feedwater heaters which tend to increase the efficiency of the high-pressure steam plant

22.11 Identify the three basic types of feedwater heaters

22.12 Describe the method used to control the level of the feedwater in the storage tank at the bottom of the open heater

22.13 Explain the reason why contaminated exhaust steam may be used to heat feedwater in a closed feedwater heater

22.14 Identify the two types of deaerators used in high-pressure steam plants

22.15 Explain feedwater treatment methods

22.16 Draw single-line sketches of the following feedwater heaters correctly located in a high-pressure system in relation to the boiler and feed pump:

- an open-type feedwater heater
- a closed-type feedwater heater

STEAMFITTER - LEVEL 2

S0928.23 Superheaters

Duration: Total 3 hours Theory 2 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the construction features and operation of superheaters.

LEARNING OUTCOMES AND CONTENT

23.1 Describe the fundamental construction features and operation of superheaters

23.2 Define the term "superheated steam"

23.3 State the main reason for the increased use of superheated steam for power plants

23.4 State the main reason for using superheated steam for turbines

23.5 Identify the two basic types of superheaters

23.6 Explain the meaning of "integral-type unit" as it relates to superheaters

23.7 Describe where the convection-type superheater coils are located within the boiler

23.8 Describe where the radiant-type superheater coils are located within the boiler

23.9 Describe the relationship in convection-type superheater coils between the temperature and enthalpy per pound of superheated steam and the demands and output from the boiler or generator

23.10 Describe a combination-type superheater

23.11 Explain the main advantage of using the combination-type superheater

23.12 Identify the two main reasons for using superheated steam

23.13 Illustrate a water-tube boiler showing a convection-type pendent superheated coil located within the boiler

STEAMFITTER - LEVEL 2

S0928.24 Desuperheaters

Duration: Total 2 hours Theory 1 hour Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the construction features and operation of desuperheaters.

LEARNING OUTCOMES AND CONTENT

24.1 Describe the fundamental construction features and operation of desuperheaters

24.2 Describe the purpose of a desuperheater

24.3 Identify the two basic types of desuperheaters

24.4 Explain the reason for using baffles in the spray-type desuperheater

24.5 Describe the method of heat transfer in the surface-type desuperheater

24.6 Identify the two reasons for using desuperheaters

24.7 State the main reason for reducing superheated steam to saturated steam

24.8 Identify the fluid which operates the diaphragm valve on the water line to the spray-type desuperheater

24.9 Identify the type of water that should be sprayed into the superheated steam in a spray-type desuperheater

24.10 Draw a single-line sketch of a spray-type desuperheater

STEAMFITTER - LEVEL 2

S0928.25 Blowdown Tanks and Piping

Duration: Total 3 hours Theory 2 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the construction features and operation of blowdown tanks and piping.

LEARNING OUTCOMES AND CONTENT

25.1 Describe the construction features and operation of blowdown tanks and piping

25.2 State the purpose of a blowdown tank

25.3 Identify another term for a blowdown tank

25.4 Explain the main reason for installing a blowdown system

25.5 Describe various methods used to blowdown high-pressure steam boilers

25.6 Explain the ideal time to perform boiler blowdowns

25.7 State the frequency and the length of time a valve should be opened during intermittent blowdowns

25.8 Explain why the blowdown line for continuous blowdowns is taken from just below the boiler water line

25.9 Identify the conditions which can be relieved by surface blowdowns

25.10 Identify the type and schedule of steel pipe used on blowdown lines between the boiler and the blowdown valves

25.11 Describe the reason for sleeving the blowdown pipe as it passes through the brickwork or exterior casing of the boiler

25.12 Identify the minimum and maximum size tappings in the boiler for blowdown piping

25.13 State the boiler code requirements regarding blowdown valves for steam boilers operating at over 15 P.S.I.

25.14 Identify four types of valves and cocks used in blowdown service

25.15 Describe the correct procedure for opening blowdown valves

25.16 State the minimum plate thickness used in blowdown tank construction

25.17 Draw and label single-line sketches of the following:

- three boilers showing blowdown piping, valves and tank
- a blowdown valve installation (one quick opening and one slow opening)
- a blowdown tank installation from given sizes

STEAMFITTER - LEVEL 2

S0928.26 Steam Boilers

Duration: Total 6 hours Theory 6 hours Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the construction features and operation of steam boilers.

LEARNING OUTCOMES AND CONTENT

26.1 Describe fundamental construction features and operation of steam boilers

26.2 Describe the construction features of a cast-iron boiler

26.3 Describe the construction features of a fire-box boiler

26.4 Describe the use of the Scotch marine boiler

26.5 Explain the main difference between water-tube boilers and fire-tube boilers

26.6 Explain the term "package boiler"

26.7 List the advantages of a packaged boiler

26.8 Describe the construction of a water-tube boiler

26.9 Describe the operation and types of water-tube boilers

26.10 State the advantage of a water-tube boiler as compared to fire-tube boiler

26.11 List the components of a large steam generator

26.12 State the features of a well designed boiler

26.13 Identify the factors to be considered when calculating net load of a boiler

26.14 State the factor to be considered when calculating the "square feet of equivalent direct radiation (EDR)" of a boiler

26.15 State the factors to be used when calculating boiler horsepower

26.16 State how boiler horsepower relates to heating surface ratings

26.17 Explain terminologies related to parts, construction and usage of boilers

26.18 Interpret the standards pertaining to boilers as specified by the Ontario Boiler and Pressure Vessels Act and Technical Safety Standards Authority (TSSA)

S0298.27 Steam Boiler Piping

Duration: Total 3 hours Theory 2 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the construction features of steam boiler piping.

LEARNING OUTCOMES AND CONTENT

27.1 Describe the construction features of steam boiler piping

27.2 State why the size of tappings on a steam boiler should not be reduced at the outlet

27.3 Explain why the piping to and from each boiler must be suitably valved

27.4 Name a term used for the thermal movement that occurs when the boiler is in operation

27.5 State the minimum size of the bleeder piping below the waterline on a given low pressure steam boiler Practical

27.6 Identify two basic considerations when installing steam piping above the boiler

27.7 State the reason for installing an equalizing line between the steam and condensate return piping

27.8 Explain how the Hartford loop got its name

27.9 State the purpose of a Hartford loop in steam boiler piping

27.10 Describe the reasons for the Hartford loop entering the bleeder pipe 2 to 4 inches below the boiler waterline

27.11 State two other names for the bleeder portion of boiler piping

27.12 Explain the term "priming"

27.13 Describe three conditions that could cause steam boiler priming

27.14 Explain three methods that can be used to prevent or overcome a priming condition

27.15 Illustrate a typical dry-pipe arrangement for the outlet of a steam boiler

27.16 Explain the term "foaming" in relation to steam boilers

27.17 Identify three causes of the oily scum-like substance that covers the surface of the boiler water and could result in a foaming condition

27.18 Describe two remedies for foaming

27.19 Draw the following sketches of steam boiler piping systems:

- a single-line illustration of a small cast-iron steam boiler piped to supply a gravity steam system
- a single-line illustration of a two boiler installation with the boiler piping arranged to supply low pressure steam with a condensate pump return

STEAMFITTER - LEVEL 2

S0928.28 Steam Boiler Accessories and Controls

Duration: Total 8 hours Theory 6 hours Practical 2 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the construction features of steam boiler accessories and controls.

LEARNING OUTCOMES AND CONTENT

28.1 Describe the fundamentals of steam boiler accessories and controls

28.2 Identify the maximum size for a single safety valve installed on a steam boiler

28.3 Identify the maximum size safety valve that can be fitted on a steam boiler where two or more safety valves are required

28.4 Explain the reason for cutting off the end of the discharge pipe at a 60° angle

28.5 Illustrate the reason for fitting a drip-pan elbow on the discharge piping from a safety valve on a high pressure safety valve

28.6 Identify the certifying agency whose initials are on the identification plate of the safety valve

28.7 Explain the purpose of seals on safety valves

28.8 Explain why the safety valve is referred to as a "pop" safety valve

28.9 Explain how the related pressure opens and closes the "pop" safety valve

29.10 Explain the main function of a pressure gauge on a steam boiler

28.11 Identify the name of the most common type of dial gauge

28.12 Identify the main component of the dial gauge

28.13 Describe the dial gauge that records pressure above and below atmospheric pressure

28.14 Describe the unit of measurement used for pressures below atmospheric

28.15 Explain the reason for installing a siphon between the gauge and the steam boiler

28.16 Illustrate the three basic designs of siphons used on steam boilers

28.17 State the reasons for locating a plugged tee above the siphon

28.18 Identify the two boiler accessories used to measure the correct boiler water level

28.19 Draw a single-line illustration of the typical piping connections between a watercolumn and a boiler showing gauge glass and gauge glass mountings

28.20 Determine how many inches of water remain over the top row of tubes or crown sheet when the water in the water gauge glass is at its lowest visible point

28.21 State the reason for installing a diagonally striped board behind the gauge glass Identify the type of valves used in the piping between the boiler and the water column

28.22 State the minimum size of piping required for the connection between the:
- water column and the boiler
- drain pipe from the water column

28.23 Describe the location and function of the try cocks on the water column

28.24 Describe the two basic types of fusible plugs

28.25 Identify the alloy filler metal used in fusible plugs

28.26 State the melting temperature of the filler metal used in fusible plugs

28.27 Explain the purpose and operation of a non-return (stop and check) valve

28.28 Identify correct location for a non-return (stop and check) valve

28.29 Describe the operating principle of a steam separator

28.30 Identify the two main types of steam separators

28.31 Describe the main purpose and location of soot blowers (steam lances)

28.32 Describe the types and purposes of low water cut-offs

28.33 Describe where the "built-in" type cut-off is located

28.34 Describe how the "built-in" cut-off is tested

28.35 Describe where the float and chamber low water cut-off is located

28.36 Describe how the float and chamber low water cut-off is tested

28.37 State the size of pipe used to connect a low water cut-off to a steam boiler

28.38 Identify three types of flame failure devices used to protect steam boilers

28.39 Explain three reasons why flame rods or electrodes are not favoured flame failure devices

28.40 Identify the type of rays emitted by the flame that activates electronic controls of modern burner installations

28.41 Draw the following illustrations of boiler accessories and controls:

- a fireside and waterside fusible plug
- a single-line illustration of the steam piping connecting three steam boilers with a common header, indicating the correct location of the stop and check and gate valves
- a single-line illustration of a low water cut-off installed at the appropriate
- location adjacent to the boiler it protects using 1-inch pipe and fittings
- a typical high pressure safety valve installation, indicating its location on the steam drum and the discharge piping to atmosphere
- the disc of the "pop" safety valve, indicating the skirt port holes and adjustable (angular) ring

S0928.29 Steam Boiler Feedwater Controls and Piping

Duration: Total 3 hours Theory 2 hours Practical 1 hour

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the construction features of steam boiler feedwater controls and piping.

LEARNING OUTCOMES AND CONTENT

29.1 Describe the fundamentals of steam boiler feedwater controls and piping

29.2 State the boiler code requirement pertaining to where feed or make-up water should be introduced into a steam boiler

29.3 Identify the valves and their location on feedwater piping to the steam boiler

29.4 Describe the function of the check valve on feedwater piping

29.5 Describe the function of the stop valve on feedwater piping

29.6 State the boiler code requirements pertaining to a boiler of 15 horsepower or more with a working pressure exceeding 25 P.S.I.

29.7 State the minimum size feedwater connection to a steam boiler having less than 100 square feet of heating surface

29.8 Identify the two possible locations for float-operated controls that add make-up water to the low and low-high pressure systems

29.9 State the recommended location for the feedwater controller on the receiver tank of a multiple low pressure steam boiler installation

29.10 Identify the three types of feedwater controls that regulate feedwater to high pressure steam boilers

29.11 Describe the function of the thin metal fins on the outer casing of the thermohydraulic generator type feedwater regulator

29.12 Explain the action of the thermohydraulic generator type feedwater regulator when the boiler water level drops

29.13 Explain the action of the thermostatic expansion type feedwater regulator when the boiler water level rises

29.14 Identify the parts of an injector that changes steam pressure to velocity
Identify the three sources of water supply to an injector

29.15 Describe and illustrate the pipe requirement for lifting water higher than 10 feet with an injector

29.16 Draw the following illustrations for feedwater piping Practicals:

- a single-line illustration of the feedwater connection entering the top of the boiler shell, locating the necessary piping and valves
- a single-line illustration of the feedwater/cut-off combination control installed on a low pressure steam boiler
- a single-line illustration of a high pressure steam boiler with a pump and cut-off control located at the boiler waterline and the make-up water control valve installed on the receiver tank, indicating the piping and electrical wiring
- a thermohydraulic generator type feedwater regulator installed and connected to the feedwater regulator valve
- a thermostatic expansion type feedwater regulator installed and connected to the feedwater regulator valve
- a single-line illustration of the injector installed on a high pressure steam boiler, indicating the piping and valves when the source of feedwater is a hot well

STEAMFITTER - LEVEL 2

S0928.30 Electrical Fundamentals

Duration: Total 9 hours Theory 7 hours Practical 2 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to explain and apply basic electrical theory including laws, circuits, use of electrical measuring instruments, common hazards, protective measures in accordance with government safety regulations, manufacturers' recommendations and approved industry standards.

LEARNING OUTCOMES AND CONTENT

30.1 Explain basic electrical theory as follows:
- electron theory of matter
- concept of electrical current

30.2 Define the following electrical units:
- ohms
- volts
- amps
- watts
- resistance
- voltage
- current

30.3 Explain Ohm's Law

30.4 State the safe-working rules to be followed when working with electrical equipment including:
- lockout
- tagging

30.5 Describe the particular components of simple electric circuits, including fundamentals of operation of:
- fuse
- switch
- resistance or load

30.6 State three purposes of a motor control centre

30.7 Demonstrate the operation of the following electrical measuring instruments:
- ammeter
- voltmeter
- ohmmeter
- multimeter
- clamp-on volt/ammeter

30.8 Interpret two simple wiring diagrams

30.9 Draw circuit diagrams for series, parallel and combined circuits using resistance and variable voltage supply

30.10 Solve problems using Ohm's Law on simple series, parallel and equivalent circuit

STEAMFITTER - LEVEL 2

S0928.31 Stress Relieving

Duration: Total 2 hours Theory 2 hours Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5474.0, 5475.0, 5476.0, 5481.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe the fundamentals, application, construction and operation of stress relieving.

LEARNING OUTCOMES AND CONTENT

31.1 Describe three types of residual stress in metals

31.2 Define the following terms as they apply to stress relieving:
- contraction
- stress due to higher surface cooling
- stress due to phase transformation

31.3 Explain the effects of residual stress

31.4 Identify three methods of relieving stress in welds

31.5 Describe the following three methods of stress relieving:
- mechanical
- heat
- electromagnetic

31.6 Explain the advantages and disadvantages of
- preheating welded joints
- postheating welded joints

STEAMFITTER - LEVEL 2

Number: **S0929**

Reportable Subject: **APPLIED TRADE CALCULATIONS II**

Duration: Total 24 hours Theory 12 hours Practical 12 hours

Prerequisites: Level I

Content:

S0929.1	Cube and Cube Root Calculations
S0929.2	Angles and Degrees
S0929.3	Volumes of Tanks and Cylinders
S0929.4	Boyle's Law
S0929.5	Simple and Compound Interest
S0929.6	List Price, Trade Discounts and Net Price

Evaluation & Testing: Assignments related to theory and appropriate Practical skills.
Minimum of one mid-term test during the 8-week term.
Final exam at end of term.
Periodic quizzes.

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
50%	20%	30%

Instructional and Delivery Strategies: Use steamfitting related examples in all math problem solving situations. Allowing the use of a simple calculator will be encouraged for all but estimation exercises.

Reference Materials:
IPT Pipe Trades Handbook
IPT Electronics Handbook
Alberta steamfitting modules

Recommended Equipment List: simple calculator

S0929.1 Cube and Cube Root Calculations

Duration: Total 1 hour Theory 0.5 hours Practical 0.5 hours

Cross-Reference to Training Standard: 5471.0, 5472.0, 5473.0, 5474.0, 5475.0, 5476.0, 5480.0, 5483.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to solve problems involving cube and cube root with the aid of a calculator.

LEARNING OUTCOMES AND CONTENT

1.1 Define "Cube"

1.2 Define "Cube Root"

1.3 Describe methods of estimating the "Cube" and "Cube Root" of a number

1.4 Calculate cube and cube roots using a calculator to solve piping problems

STEAMFITTER - LEVEL 2

S0929.2 Angles and Degrees

Duration Total 7 hours Theory 3.5 hours Practical 3.5 ours

Cross-Reference to Training Standard: 5471.0, 5472.0, 5473.0, 5474.0, 5475.0, 5476.0, 5480.0, 5483.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to solve problems involving angles and degrees with the aid of a calculator.

LEARNING OUTCOMES AND CONTENT

2.1 Define "Angle"

2.2 Define "Degree"

2.3 Define "Trigonometry"

2.4 Explain the use of trigonometry charts

2.5 Explain how trigonometry can be used to solve steamfitting related programs

2.6 Use applied trigonometry to solve steamfitting related programs

2.7 State the formula for tube bending allowance

2.8 Perform calculations related to bending tubing and pipe

STEAMFITTER - LEVEL 2

S0929.3 Volumes of Tanks and Cylinders

Duration: Total 7 hours Theory 3.5 hours Practical 3.5 hours

Cross-Reference to Training Standard: 5471.0, 5472.0, 5473.0, 5474.0, 5475.0, 5476.0, 5480.0, 5483.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to calculate volumes of tanks and cylinders to piping system Practicals with the aid of a calculator.

LEARNING OUTCOMES AND CONTENT

3.1 State the formulas for the volume of the following shaped tanks:
- square
- rectangular
- cylindrical
- spherical
- hemispherical
- combinations of the above

3.2 Identify weight and volume units contained in the following systems:
- Imperial
- U.S.
- metric

3.3 Calculate the capacity, in Imperial gallons, of a square or rectangular tank of given dimensions

3.4 Calculate the weight of water, in pounds, contained in a square or rectangular tank of given dimensions

3.5 Calculate the capacity, in Imperial gallons, contained in a cylinder (flat ends) of given dimensions

3.6 Calculate the weight of water, in pounds, contained in a cylinder (dished ends) of given dimensions

3.7 Convert three given volumes and three given weights in Imperial units to equivalent metric units

3.8 Convert three given volumes and three given weights in metric units to equivalent Imperial units

3.9 Calculate the average weight per pipe hanger to support a length of pipe during a hydrostatic test given:

- size of pipe
- type of pipe material
- pipe schedule
- length of pipe
- minimum number of pipe hangers per linear unit
- appropriate charts giving the weights of various pipe per linear unit

3.10 Calculate the force on each of four legs of a spherical tank half filled with water, given:

- the inside diameter of the tank
- the weight of the tank when empty
- the surface area at the bottom of each leg

STEAMFITTER - LEVEL 2

S0929.4 Gas Laws

Duration: Total 7 hours Theory 3.5 hours Practical 3.5 hours

Cross-Reference to Training Standard: 5471.0, 5472.0, 5473.0, 5474.0, 5475.0, 5476.0, 5480.0, 5483.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to solve trade related problems involving gas laws with the aid of a calculator.

LEARNING OUTCOMES AND CONTENT

4.1 Define Boyle's Law

4.2 State the formula for Boyle's Law

4.3 Apply Boyle's Law to solve trade-related gas volume and pressure problems

4.4 Define Charles Law I and II

4.5 State the formula for Charles Law I

4.6 State the formula for Charles Law II

4.7 Apply Charles Law I and II to solve trade related gas, volume and pressure problems related to steamfitting

S0929.5 Simple and Compound Interest

Duration: Total 1 hour Theory 0.5 hours Practical 0.5 hours

Cross-Reference to Training Standard: 5471.0, 5472.0, 5473.0, 5474.0, 5475.0, 5476.0, 5480.0, 5483.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to solve simple and compound interest with the aid of a calculator.

LEARNING OUTCOMES AND CONTENT

5.1 Define "simple and compound interest"

5.2 Solve given trade-related problems involving simple and compound interest

S0929.6 List Price, Trade Discount and Net Price

Duration: Total 1 hour Theory 0.5 hours Practical 0.5 hours

Cross-Reference to Training Standard: 5471.0, 5472.0, 5473.0, 5474.0, 5475.0, 5476.0, 5480.0, 5483.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to solve trade related problems involving list price and trade discounts with the aid of a calculator.

LEARNING OUTCOMES AND CONTENT

6.1 Define the following:
- list price
- trade discount
- selling (net) price

6.2 Calculate the selling (net) price of trade-related items given the list price and trade discount

STEAMFITTER - LEVEL 2

Number: **S0930**

Reportable Subject: **TRADE DOCUMENTATION II**

Duration: Total 24 hours Theory 11 hours Practical 13 hours

Prerequisites: Level I

Content:

S0930.1 Template Development
S0930.2 Drawings and Blueprints
S0930.3 Applied Business Practices

Evaluation & Testing: Assignments related to theory and appropriate Practical skills.
Minimum of one mid-term test during the 8-week term.
Final exam at end of term.
Periodic quizzes.

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
50%	20%	30%

Instructional and Delivery Strategies: Use of templates in shop projects will test the theory of template development and reinforce the need for accuracy.

Reference Materials:

Template Development for the Pipe Trades
IPT Pipe Trades Handbook
Pipe Fitters and Pipe Welders Handbook

Recommended Equipment List:

drafting tables
T" square
template paper
compass
30°, 60° and 45° set squares
protractors
french curve

STEAMFITTER - LEVEL 2

S0930.1 Template Development

Duration: Total 15 hours Theory 6 hours Practical 9 hours

Cross-Reference to Training Standard: 5471.0, 5472.0, 5473.0, 5474.0, 5475.0, 5475.0, 5476.0, 5480.0, 5483.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe and illustrate template development.

LEARNING OUTCOMES AND CONTENT

1.1 Describe template development for a two-piece 45° elbow

1.2 Describe the uses for a two-piece 45° elbow

1.3 Illustrate lines, angles and circles, and bisect and divide them into equal divisions

1.4 Define drawing reference points

1.5 Describe template development for a two-piece 90°elbow

1.6 Describe the uses for a two-piece 90° elbow

1.7 Explain why two-piece 90° elbows are seldom used to convey liquids

1.8 State the internal measurement of a 6-inch two-piece 90° elbow at its widest point

1.9 Calculate the developed lengths of the template for a 6-inch pipe (6 5/8-inch O.D.) using 1/16-inch gasket material

1.10 Calculate the developed length of the template for a 2 ½-inch pipe (2 7/8-inch O.D.) using 1/8-inch gasket material

1.11 Describe template development for a three-piece 90° elbow

1.12 State the angle of cut for a three-piece 90° elbow

1.13 State the angle of cut for a four-piece 90° elbow

1.14 Name the three main factors to be considered in developing a template for a multi-piece elbow

1.15 State the center-line dimensions for a three-piece 90° elbow with a specific radius

1.16 State the developed length of the template for a 3-inch pipe

1.17 Describe template development for a 45° lateral

1.18 Explain the reason fabricated lateral tees are used instead of manufactured lateral tees

1.19 State the main disadvantage of using a lateral tee in a run of pipe

1.20 Name two procedures which will minimize the bending of the pipe

1.21 State the developed length of the template for a 3-inch pipe (3 ½-inch O.D.)

1.22 Describe the complete template development for a 45° lateral tee using 3-inch pipe (3 ½-inch O.D.)

1.23 Describe template development for reducing 45° lateral

1.24 Explain the main difference between the cut lines for a full-size lateral tee and a reducing lateral tee

1.25 Explain two reasons for the recommendation that the inside diameter be used for the plan view of the branch

1.26 Explain the main difference between the development of the hole in the run for a full-size lateral and the development of the hole for a reducing lateral

1.27 Develop templates necessary to fabricate shop projects such as a 45° lateral reducing tee using 4-inch pipe for the run and 3-inch pipe for the branch

STEAMFITTER - LEVEL 2

S0930.2 Drawings and Blueprints

Duration: Total 6 hours Theory 4 hours Practical 2 hours

Cross-Reference to Training Standard: 5471.0, 5472.0, 5473.0, 5474.0, 5475.0, 5475.0, 5476.0, 5480.0, 5483.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe and illustrate the use of drawings and blueprints.

LEARNING OUTCOMES AND CONTENT

2.1 Describe the use of isometric drawings

2.2 State the purpose of a pictorial drawing

2.3 Identify the three most common types of pictorial drawings

2.4 Identify the type of pictorial drawing most frequently used

2.5 State the angle at which lines representing lengths and widths are drawn and labeled

2.6 State the angle at which lines representing heights are drawn and labeled

2.7 Describe how you would begin an isometric drawing

2.8 Illustrate how overall dimensions are drawn and labeled

2.9 Illustrate how non-isometric lines are drawn and labeled

2.10 Illustrate how extension lines are laid out for length and height

2.11 Illustrate how dimension lines are drawn and labeled

2.12 Illustrate how horizontal pipes are shown on an isometric drawing

2.13 Illustrate how vertical pipes are shown on an isometric drawing

2.14 Describe how to identify piping elevation drawings

2.15 Explain the reason piping systems are drawn and labelled in elevation

2.16 Describe the procedure for laying out a piping elevation drawing

2.17 Explain the reason for darkening the piping and fitting lines on a drawing

2.18 State the purpose of sleeving for a piping system

2.19 List the different types of sleeves required prior to a concrete pour

2.20 Define the following terms:

- temporary sleeving
- permanent sleeve
- waterproof or water tight sleeve
- sleeve template
- fire stopping
- insulation

STEAMFITTER - LEVEL 2

2.21 Describe the construction features and Practicals of sleeves including:
- types of materials for temporary, permanent, water tight joints
- recommended lengths for temporary and permanent sleeves
- sleeve sizes for given pipe sizes
- use of a sleeve template

2.22 Describe the recommended securing procedure for sleeves prior to a concrete pour

2.23 Develop a plan view showing the location, number and diameter of sleeves for a given steamfitting practical

STEAMFITTER - LEVEL 2

S0930.3 Applied Business Practices

Duration: Total 3 hours Theory 1 hour Practical 2 hours

Cross-Reference to Training Standard: 5471.0, 5472.0, 5473.0, 5474.0, 5475.0, 5475.0, 5476.0, 5480.0, 5483.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to prepare applied business practice documents.

LEARNING OUTCOMES AND CONTENT

3.1 Prepare trade related reports, forms and business letters

3.2 Prepare a trade-related technical report for oral presentation

3.3 Complete a workers' compensation form given relevant information

3.4 Complete an industrial accident report form given relevant information

3.5 Fill out a sample work order form for hypothetical work done, given an appropriate set of conditions and parameters

3.6 Write business letters pertaining to:
- customer job enquiries
- acknowledgment of orders
- claims for goods damaged in shipment

3.7 Interpret a given sample purchase order including "fine print" items

3.8 Prepare a hypothetical purchase order identifying the following products (including model or part number)

- quantities
- price
- discounts
- taxes
- freight charges
- delivery terms

STEAMFITTER - LEVEL 2

Number: **S0931**

Reportable Subject: **WELDING II**

Duration: Total 24 hours Theory 3 hours Practical 21 hours

Prerequisites: Level I

Content:
S0931.1 Electrical Arc Safety
S0931.2 Shielded Metal Arc Welding Procedures
S0031.3 Butt Weld Mild Steel

Evaluation & Testing: Assignments related to theory and appropriate Practical skills.
Minimum of one mid-term test during the 8-week term.
Final exam at end of term.
Periodic quizzes.

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
20%	50%	30%

Instructional and Delivery Strategies: Delivery of theory and practical will be closely aligned. Use of templates from the Trade Documentation II reportable subject to build shop projects will test the theory of template development. The use shop project fabricated pipe fittings from Pipe Fabrication II reportable subject classes will reinforce the need for well fitted welding joints.

Reference Materials:
IPT Metal Trades Handbook
IPT Pipe Trades Handbook
Alberta steamfitting modules

STEAMFITTER - LEVEL 2

Recommended Equipment List:

shielded metal arc welding equipment and supplies
protective safety equipment including goggles, hearing and breathing protection
approved ventilated welding area
welding booths
grinders
files
wire brushes

STEAMFITTER - LEVEL 2

S0931.1 Electrical Arc Safety

Duration: Total 1 hour Theory 1 hour Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5473.0, 5474.0, 5475.0, 5476.0, 5479.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to describe electrical arc welding safety precautions in accordance with government safety regulations and approved industry standards.

LEARNING OUTCOMES AND CONTENT

1.1 Describe the safety factors regarding electrical arc protection:

- protective clothing
- eye protection
- hand protection
- safety footwear
- electrical current hazard
- fumes
- effects of moisture

STEAMFITTER - LEVEL 2

S0931.2 Shielded Metal Arc Welding Procedures

Duration: Total 2 hours Theory 2 hours Practical 0 hours

Cross-Reference to Training Standard: 5472.0, 5473.0, 5474.0, 5475.0, 5476.0, 5479.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to identify, state and apply shielded metal arc welding procedures in accordance with government safety regulations, manufacturers' recommendations and approved industry standards.

LEARNING OUTCOMES AND CONTENT

2.1 Describe the fundamentals of shielded metal arc welding

2.2 State the difference between straight and reverse polarity

2.3 Comprehend welding symbols

2.4 Describe the construction features and operation of shielded metal arc welding equipment and supplies

2.5 State how to test for polarity

2.6 Identify the meaning of the numbers in the AWS electrode code classification

2.7 Name four types of electrodes commonly used in the trade

2.8 List two common sizes of electrodes

2.9 State what determines electrodes size

2.10 State the purpose of the coating on electrodes

2.11 List factors to consider when selecting an electrode for a specific job Practical

2.12 Describe the storage procedure for electrode

2.13 Identify common arc welding faults and describe methods of control

2.14 State five causes of poor welds

2.15 State two reasons for removing slag from weld

2.16 State three reasons for fusing one bead in with another

2.17 List four factors that determine weld quality

2.18 State reasons for polarity changes

STEAMFITTER - LEVEL 2

S0931.3 Butt Weld Mild Steel

Duration: Total 21 hours Theory 0 hours Practical 21 hours

Cross-Reference to Training Standard: 5472.0, 5473.0, 5474.0, 5475.0, 5476.0, 5479.0, 5484.0

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice is able to butt weld mild steel in the flat, horizontal and overhead positions using shielded metal arc welding equipment.

LEARNING OUTCOMES AND CONTENT

3.1 Select the correct electrode according to factors governing job requirements

3.2 Set up and adjust the welding machine prior to welding

3.3 Check equipment for safe operating condition

3.4 Prepare, tack and butt weld mild steel plate in the flat, horizontal and overhead positions

3.5 Strike and maintain an arc on mild steel plate

3.6 Lay beads on steel plate or pipe

3.7 Weld the pipe projects from the Pipe Fabrication II reportable subject